SECTION 3

IMPACTS OF LIMITING CONSUMPTION

3.1 Overview

There are positive and negative impacts of fish advisory programs which merit consideration when developing new programs or modifying existing ones. Options for limiting fish consumption are seriously considered only when sampling and analysis data indicate that fish consumers may be at risk. In addition to the obvious benefits of reducing health risks, there are other positive and negative impacts of fish advisories that may affect either the entire population or a subgroup of the population in an area. For example, posting fish advisories may be beneficial in educating people about the hazards of a water body, leading to less swimming, water use, and attention to the need for clean-up. Alternatively, posting may reduce the availability of fish as a dietary component or component of a traditional ceremony, and may jeopardize the livelihood of small businesses reliant on fishing activities. Under most circumstances, consumption advisories will have both positive and negative effects on individual consumers and their communities. These effects should be considered by decision-makers in developing a fish advisory program.

This section explores some of the potential impacts of various options for limiting fish consumption on groups and activities EXTERNAL to the governing body. Affected groups may include the target population or communities and individuals that serve them (e.g., fishing equipment stores). The impacts are, for the most part, site specific. Whether they should be a consideration in decision-making, and the extent of their impact, will depend on local conditions including the population, economy, social and cultural features, and other factors. Consequently, in reviewing this information the reader is urged to evaluate the information in light of the characteristics of the contaminated areas.

3.2 Nutrition

3.2.1 Basic Nutritional Needs

Fish consumption is generally beneficial because it provides a good source of protein and vitamins. Although fish composition varies, a 3.5 ounce fillet generally provides the nutrients listed in Table 3.1 (larger fillet may be consumed in practice).

The protein content of fish is high in relation to the fat content of most fish species (Anderson, et al, 1972). The nutritional components of fish will vary depending on the method of preparation, storage, and what portion of the fish is consumed and varies by species.

Table 3-1. Nutrient Values for 3.5 oz Fish Fillet

calories	98 - 236
protein	15 -29 grams
calcium	6 - 260 milligrams
potassium	190 - 414 milligrams
iron	0.7 - 2.2 milligrams
vitamin A	30 - 1050 I.U.
vitamin B:	
Thiamine	0.02 - 0.16 milligrams
Riboflavin	0.07 - 0.27 milligrams
Niacin	1.9 - 13.3 milligrams

Taken from Anderson et al., 1972. Table 1.

U.S. FDA has provided recommended dietary allowances for vitamins and minerals that can be compared to the above information to determine the contribution fish may make for various age groups and with different portion sizes (NRC, 1989). Although vitamin and mineral supplements are readily available at a relatively low cost, individuals who reduce their dietary intake of these essential nutrients from fish will not necessarily obtain supplements or consume other foods with these nutrients. More problematic is the access to high quality protein for many people with limited incomes. For some low income populations who rely on subsistence fishing for dietary protein, fish consumption is an essential part of their diet and an economic necessity.

3.2.2 Health Benefits of Fish Consumption

In addition to fulfilling basic nutritional needs, eating a diet rich in fish may also convey several health benefits. Restrictions in the amount or type of fish consumed may negatively impact the health of individuals who had been benefiting from fish consumption. Whether or not a negative impact will occur depends on what other foods are substituted for the fish. Substitutions may include other types of fish, or

non-fish sources of protein.

Impacts of restricted consumption depend on whether or not the consumers were benefiting from consuming fish in a manner that can or will not be replicated by other foods. The many human studies showing positive effects of fish consumption focus primarily on fish diets versus traditional western diets that may be high in salt, cholesterol, and saturated fats. The impact of switching from a fish-intensive diet to another "healthy" diet is less well understood. The following discussion identifies specific benefits that may be derived from fish or fish constituent (e.g., fish oil) consumption. When reviewing this information, risk managers may wish to consider the health status of target populations, their likely substitutions for fish, and how a fish advisory program can minimize the adverse impacts of fish consumption reductions.

Benefits of fish consumption have been identified in human epidemiological studies that compared the health status in fish consuming populations with those in populations consuming little or no fish. Many studies that identified these benefits have focused on the ingestion of fish oil; however, some have evaluated consumption of all edible portions of fish. The array of demonstrated benefits includes decreased cardiovascular disease, a reduction in blood pressure in hypertensive and non-hypertensive individuals, reduced risk of colon cancer and breast cancer, several benefits to diabetic patients, decreased pain from arthritis, and a decreased incidence of asthma attacks in asthmatics. In addition to epidemiological studies, animal research has also found associations between fish or fish oil and health benefits. The discussion below focuses on the findings of the human studies.

Cardiovascular Disease Reduction

More information is available on the association between fish and cardiovascular disease than between fish and other diseases. Studies have shown beneficial effects from eating fish oils, ranging from decreased coronary heart disease (CHD) mortality to decreases in blood pressure and decreased serum lipids.

Mortality from CHD has been shown to be low in many fish-eating populations and in clinical studies on the effects of eating fish and fish oils. Eskimo and Japanese populations who eat large amounts of fish have been shown to have low incidence of CHD and CHD mortality (Kromhout, 1993). These results may be due in part, however, to the relatively low amount of saturated fats in the diets of these populations. Saturated fats are considered a risk factor in CHD and a diet with low levels is associated with a lower than average risk of heart disease.

Prospective studies on the individual level are important to more accurately determine the correlation between fish consumption and CHD mortality. A 20-year prospective study on 852 men in the Netherlands found that CHD mortality (independent of other CHD risk factors) was inversely related to the amount of fish consumed (Kromhout, et al., 1985). Three other cohort studies showed similar results (Shekelle et al., 1985; Norell et al., 1986; Dolecek and Grandits, 1991). An intervention trial in Wales of 2,000 patients supports the results of the observational studies that have shown associations between fish consumption and reduced mortality (Burr et al., 1989). In this study, patients who were recovering from heart attacks and who ate at least two portions of fatty fish per week reduced their mortality by one third compared to patients who received advice on fat or fiber but did not consume fish biweekly. Other research in populations that generally consumed large amounts of fish, however, has demonstrated no association between fish consumption and mortality (Kromhout, 1993). This failure to find an association may be due to lack of a control group of individuals who do not consume fish.

Omega-3 fatty acids[1] have beneficial impacts on health, but the concentrations of these beneficial chemicals in fish tissue varies by fish species. Fish oil has been shown to reduce blood pressure (Kromhout, 1993), although the dose required for this effect has not been determined. In one study, mildly hypertensive men who received 50 ml fish oil (equivalent to 15 grams of omega-3 fatty acids) a day for four weeks had significantly lower blood pressure during the treatment period than they did at the beginning of the study (Knapp and Fitzgerald, 1989). Men who ingested either 39 grams omega-6 fatty acids from safflower oil, a mixture of oils representing the average U.S. diet, or a 10 ml dose of fish oil (omega-3 mg equivalent not provided) exhibited no decrease in blood pressure. The blood pressure of those receiving the high dose of fish oil returned to pre-study levels after the subjects stopped taking the oil. One study in which individuals ate fish in quantities that may represent normal daily intake values by the general population (1.2 grams of omega-3 fatty acids/day) showed that blood pressure was lowered after 8 months of the regimen (Simopoulos, 1991). Changes in physiology related to hypertension have also been noted in human studies. Twenty patients who had high levels of fatty acids at the outset of the study were given a diet containing fish oil, which consisted of about 20 to 30 percent of each patient's diet. Over the four-week diet, the patients exhibited decreases in cholesterol, fatty acid, and very low-density lipoprotein levels (Phillipson, et al., 1985). Several other clinical studies have shown fish oils to lower serum lipids (Dattilo, 1992).

Diabetic Symptom Reduction

[1] Omega-3 fatty acids are found in fish oil.

Recent evidence suggests that fish oil may benefit diabetic patients. Ingestion of cod-liver oil for eight weeks by diabetic patients resulted in a variety of effects: decreased permeability of blood vessels to macromolecules such as lipoproteins, reduced blood pressure, increased amount of high density lipoproteins, and decreased amounts of very-low density lipoproteins and triglycerides (Jensen et al., 1989). In contrast, olive oil resulted in no significant decrease in either blood pressure or blood vessel permeability, and the subjects' levels of very-low density lipoproteins and triglycerides increased. The decreased vascular permeability seen in the patients eating fish oil may prove beneficial because it prevents the progression of diabetic nephropathy by decreasing permeability to albumin. Long-term studies need to be undertaken to determine whether this mechanism actually occurs. Other studies on insulin-dependent and non-insulin-dependent diabetes patients have shown small increases in blood glucose, glycosylated hemoglobin, plasma total cholesterol, LDL cholesterol, and serum apo B associated with fish oil ingestion (Simopoulos, 1991).

Arthritic Symptom Reduction

McVeigh (1990) reviewed research on the effects of fish oil on arthritic patients. In one study of 49 patients, those given fish oil for six months had decreased morning stiffness, pain, and fatigue. The effects were dose related, with higher doses of fish oil resulting in greater improvement. These results are corroborated by other studies demonstrating similar beneficial effects to arthritic patients ingesting omega-3 fatty acids from fish oil (McVeigh, 1990).

Asthmatic Symptom Reduction

Nine asthmatic patients treated with fish oil lipid capsules had significantly fewer asthmatic episodes than eight patients taking placebos (Arm et al., 1989). It has been suggested that fish oil may confer anti-inflammatory effects, which leads to the observed decreases the severity of symptoms in both arthritic and asthmatic patients.

Cancer Risk Reduction

The protective effects of eating fish may extend to reducing the risk of getting certain cancers. A study of 88,751 nurses found that those nurses with a daily consumption of fish or chicken had lower risk of getting colon cancer than those with a lower consumption rate (Willett et al., 1990). Other research has shown that fish may reduce the risk of breast, colon, pancreas, and prostate cancers (Simopoulos, 1991).

The research described above indicates that fish may convey significant health benefits for those with certain medical conditions, as well as the general population. Some health experts believe that the health benefits outweigh the risks associated with fish contaminants (e.g., Kimbrough, 1991). EPA is not indicating an acceptance of or agreement with the study results by reporting these studies. Agencies may wish to review the studies in more detail to determine the applicability of their results to the risk management process.

There is not yet sufficient information to determine precisely what levels of fish consumption are associated with specific health benefits. However, the positive benefits of fish consumption may be considered when evaluating the trade-offs between various risk management options. An evaluation of the benefits and risks of fish consumption, which may include careful consideration the levels of contamination, risks associated with contaminants, potential benefits to fish consumers, and the availability of alternative economically feasible food supplies and their associated risks.

It would also be useful to have information regarding the health risks associated with alternative forms of protein that would replace the fish formerly consumed by fishers who alter their dietary habits based on advisories. Information exists on many of the pesticides, preservatives, and drugs used in the production, processing, and preservation of meats, dairy products and vegetarian alternatives. Conversely, no comprehensive data exist on the overall risks and benefits associated with these products. It is beyond the scope of this document to evaluate such risks. When establishing fish advisories risk managers may wish to consider that alternatives to fish also may be associated with risks.

Under ideal circumstances, contaminants in fish will be eliminated through better environmental controls. Until that time, regulatory limits and advisories based on an evaluation of risks and benefits should provide the fish consumer with sufficient information to reap the benefits of eating fish while avoiding unsafe exposures to contaminants.

3.3 Cultural and Societal Impacts

While decision-makers often focus on the risks and benefits of various policy decisions or the feasibility and cost of programs, affected populations often perceive decisions and programs from the point of view of impacts on their lives or

effects on their communities.[2] To be appropriately designed and effective, risk evaluations and programs to reduce risk must take into consideration the needs and perceptions of the community being exposed. These impacts should also be considered when decision-makers are evaluating trade-offs between different program options and establishing consumption limits.

In most cases there will be trade-offs for individuals and communities if restrictions in fish consumption are advised. This section provides a discussion of potential impacts on social and cultural aspects of individuals and communities. The information obtained in this section was obtained primarily from discussions with members of Native American, Asian American, African American, and Hispanic communities and sport and urban fishers groups. State and federal workgroup members with information on cultural impacts were also consulted. Formal surveys were not conducted for this document; consequently, the information provided represents a summary of what was learned through conversations with a range of individuals and does not reflect a representative sampling of fisher groups or government agencies. Readers are urged to submit information for future revisions to EPA's Fish Contamination Program.

3.3.1 Traditional Activities

Fishing and fish consumption are a part of the traditional activities of many groups. These range from Native Americans who employ fish in religious and secular ceremonies to urban fishers who engage in sport fishing activities during specific seasons as a part of their social activities. The importance of these activities to the communities and participants is significant and cannot be quantified in the same way that risks or dollars lost on tourism are quantified. The value of these activities to individuals and groups may vary from something that is a pleasant intermittent pastime to an essential part of a long-standing culture and personal identity. The effects of imposing fishing restrictions on individuals and groups merit evaluation prior to taking any significant action.

The cultural and spiritual practices of subsistence fishers may be affected by fishing advisories. One population most affected are Native Americans, where traditions have been built around fishing and sharing the catch for centuries (EPA, 1994b). Native American groups have used fish in their traditional religious activities over

[2] Communities in this context refers to a group of people who share similar cultural patterns and who consider themselves to be member of the same societal group. A community may be a tribe, ethnic group, small town or part of a city. Subpopulations within the community may be identified to obtain groups who have similar activities, susceptibilities and needs.

many centuries. While the wide diversity of beliefs among the hundreds of tribes in the United States makes generalizations regarding their beliefs inappropriate, nature plays a large role in the religious beliefs and activities of many tribes. Those tribes near large waterbodies, such as the Great Lakes and Atlantic and Pacific Oceans, have often used particular types of fish to symbolize characteristics or ideas. The fish are used in ceremonial meals, and the catching of fish may also be a part of the traditional activities.

The Columbia River Inter-Tribal Fish Commission (CRITFC), composed of four tribes that fish along the Columbia River Basin, has been involved in evaluating fish contamination and its various impacts on the tribes. In their report on the results of their studies, they preceded all technical information with a statement under tribal health:

> "Fish is not just a major food source for tribal members, it is the essence of the tribes' cultural, economic and spiritual well-being."

(CRITFC, 1994).

Such a statement placed in a position of prominence in the report indicates the importance of fish to these tribes.

Many tribal affiliates have explained that at least two of the options for limiting the consumption of contaminated fish, outright bans and catch and release programs, would be completely inconsistent with the cultures relying on fishing for subsistence and cultural sense of self (Watanabe, 1994; Kmiecik, 1994; Coombs, 1994; Cole, 1994; Dellinger, 1994; Walker, 1994). To those who are a part of a culture defined by the societal relationship to fishing (and providing for themselves) and concepts of efficient living, fish advisories are especially troubling. Restrictions on fishing rights have also been perceived by some individuals as passing the negative impacts of contaminated waters from the polluters who should be responsible for cleaning the waters to socio-economically disadvantaged communities or clusters of individuals with little political clout. Fishing represents the integration of family with community responsibility. Families spend time together fishing, and communities try to maintain interests in the harvests and management of both anadromous and resident fishes. These acts and that of preparing fish for use when the fishing season slows down and the anadromous fish have left provides a sense of community (Cole, 1994; Coombs, 1994).

For many of these tribes that rely on fishing as a major part of their economic and nutritional base, fishing advisories are an apparent sign of disrespect to their

communities and cultures. They perceive the message that those responsible for the unhealthy water contaminant levels are not required to clean the water to a level that is safe to consume the fish, and are viewed by the external decision-makers (i.e., government) to be more important than the individuals that choose to supplement their diets with fish (Watanabe, 1994; Cole, 1994).

Specific ceremonial uses of fish, such as the First Fish ceremonies to celebrate the first fish of the seasons, are vital to the maintenance of cultures living off the land and water. Such ceremonies may require consuming parts of the fish not typically consumed, or having everyone who is present consume parts of the fish, including nursing mothers and children. For example, the First Fish ceremony among the tribes of northern California includes the consumption of the entire fish while returning the bones back to the river (Coombs, 1993; Walker, 1994). The Objibwa (Chippewa) of the upper Great Lakes region, another community that depends upon fish as a food source and an important economic base, have a well documented history of fishing cultures, including subsistence and commercial fishing. Extra fish are distributed among crew members and the extended family for labor compensation as part of cultural ritual and tradition (Dellinger, 1993).

People for Community Recovery, an African American urban community organization in Chicago, has raised up additional concerns. Many of the waterways in urban stretches are not visibly posted with any advisories, although advisories have been released for those areas by the State. These areas are used by numerous subsistence fishers who supply fish to their immediate and extended families and supplement their incomes by selling the fish they catch to the local community. These fishers often do not pick up the sportsfisher guides available (typically via fish license distributors) and may be unaware of the potential health hazards from eating fish from these waters. Consequently, these particular fishers are unlikely to know the particulars of the fish advisories released by the State, and the consumers are even more unlikely to have been informed of the health advisories. Fish bans or catch and release recommendations may not be a realistic risk management option in these communities, and enforcement would be extremely difficult. The current practice of no postings, however, has left many urban fishers feeling that their health is being compromised because they are not considered to be a valued part of the community.

Posting as much information as possible in a brief format, including types and quantities of fish that are safe to eat, is most important to them. Two main concerns that affect urban African American populations in this area, which could be addressed through fish advisory and local community programs, are the existence of informal fish markets and communication of safe preparation techniques. In both of these instances, the individuals eating the fish may not have been made aware

of which types and quantities of fish are safe to eat. Although many African Americans have been switching to cooking methods that reduce the amount of fat, the preferred method is still frying a skin-on fillet or deep frying the whole gutted fish. Of the preferred fish to consume, several species are bottom fish such as catfish and buffalo fish, although increasingly many of these are farm raised. These individuals typically require the fish as a part of their diet and as a supplemental or primary form of income necessary for their family (Williams, 1994). Although advisory information may not change all of the fishers' behavior, the information will allow them to make their own informed decisions.

Even when advisories are posted, fishers may ignore the warnings. The Hudson River Sloop Clearwater (HRSC) environmental group conducted a survey of individuals who supplement their diet and income with fish from the Hudson. An ad-hoc interview of individuals fishing the river after the survey found that some anglers think the fishing advisories are "a big fairy tale." There is a strong belief among some fishers that if the fish "look okay", or if fishers are "still alive," then no problems exist (HRSC, 1994). Such beliefs are a testament to the need for advisory postings that first are available to everyone and, more importantly, are explained clearly so that individuals who are purchasing or receiving fish can make educated decisions about the quantity to consume.

Sport fishers also form an informal community that may provide support and essential relaxation for those who participate. For many this activity may be their primary hobby and their outlet to escape the stresses of everyday life. For many, fishing is a social activity. Even non-fishers participate in the festival-like atmosphere that surrounds some fishing periods, such as the smelt runs in Chicago. Other subpopulations where fishing and/or fish consumption are an important part of the culture and traditions include some Asian American communities, and long-time subsistence and commercial fishing communities such as Chesapeake Bay fishers (EPA, 1994b).

Many people have participated in sports fishing activities over their lifetimes and it is not uncommon to see many generations spending time together fishing. As with Native American impacts, the importance of fishing to sports fishers and to their communities should be considered carefully when evaluating fish advisory actions. Cultural and spiritual values are extremely difficult to quantify. Nonetheless, states should consider the effect that restricting a fishery will have on these values when deciding whether or not to issue a fish advisory.

Although the value of traditional activities to communities cannot be quantified in dollars, the importance of fishing and fish consumption to these communities may be great. A high value may be placed on the ability to fish in traditional fishing

areas and to obtain food from nature. Both direct restrictions of fishing and less intrusive fish advisories may also have strong implications for communities with respect to the degradation of lands and waters that they hold sacred. For these groups in particular, remediation of contaminated waters and fish may be an especially high goal. In some cases, moving the fishing grounds to other locations or limiting fish consumption to minimize risk may seem far less appropriate than it would seem to fishers with differing attachments to the land. The cultural implications of programs should be considered carefully in designing risk reduction programs. Input from targeted populations may be especially important in cases where traditional ways will be disrupted by such programs.

Supplement A in Volume II has a detailed discussion of some specific groups of subsistence fishers' dietary patterns. It also provides information regarding the importance of fish both as a food source and in their cultural lives. This section should be consulted for additional information on the topic.

3.3.2 Dietary Patterns

Nutritional advantages of fish consumption were discussed in an earlier section, but specific health benefits are not the only issue related to dietary restrictions such as fish advisories. In many cultures within the U.S., particularly Asian American and Native American groups, fish consumption is a long-standing tradition, with recipes passed from generation to generation. Other groups also have dietary traditions making extensive use of fish. As noted above, fish are an important component of the diet of many urban and rural poor, as well as those who fish for sport rather than economic necessity. Restrictions in fish consumption may provide a hardship to those who have spent years cooking in familiar ways. It may be difficult or impossible to substitute ingredients for fish, and the taste may not be palatable to those accustomed to traditional fish dishes.

If substitutions are made for fish, the replacements may be less healthy (see the health benefits section, 3.2) and may not be financially practical for subsistence fishers. Many alternative western foods are higher in saturated fats, salt, and other undesirable components. Considering the potential impacts on the dietary patterns of targeted populations is encouraged in developing fish advisory programs.

3.3.3 Use Taking and Mobility

People who have property that has traditionally entitled them to fish may suffer significant negative impacts from fish advisories (commercial issues are discussed in the following section). These individuals may be owners of property where they have carried out recreational or subsistence fishing, or tribal members with treaty

rights to waterbodies. Such people may feel that restrictions, particularly involuntary restrictions, on fishing are an infringement on their property rights. Native American groups have characterized such activities as use taking in a legal sense.

Fishers who have the option of using alternate waterbodies without advisories (or with less stringent advisories) are not affected in the same way as those who have specific rights regarding shore line or water property. Aside from any commercial valuation, property owners may feel that the value of their property to themselves is severely diminished if the fish are contaminated to an extent requiring fish advisories.

3.4 Economic Impacts of Fishing Advisories

States should keep in mind that the imposition of fish advisories may result in various social costs. For example, fish advisories may decrease the values of properties abutting affected waterbodies used for fishing. The cost of obtaining food containing high quality protein may increase for subsistence fishers who must find alternative protein sources. The magnitude of these costs will depend on the species of fish affected, the degree of fishing (sport and subsistence) taking place before or after the advisory, the quantity of fish tissue consumption allowed post-advisory, and the effect of ingesting contaminated fish tissue on sensitive subpopulations such as children. These social costs can be defined as the negative impact of fish advisories on human society. When evaluating whether or not to issue a fish advisory, however, these social costs must be weighed against the social benefit of reducing adverse effects to human health.

In general, social costs and benefits can take several forms. They can include impacts on goods and services with clearly defined markets such as commercial fisheries. Alternatively, they can include impacts on items that society cares about but are not traded on markets such as contaminant-free water. Finally, other social costs and benefits may have components that can be valued through market transactions and other components for which a dollar value is cannot be set by the marketplace. Adverse health effects are a good example of this situation. While health effects can lead to losses in productivity and wages that are easily monetized, they will also lead to pain and suffering, which are more difficult to value.

This section focuses on the three categories of social costs and benefits associated with fish advisories. These categories are:

- **Costs Associated with Fishing** -- includes potential economic losses to the recreational fishing industry, costs to anglers, price increases of protein sources for subsistence fishers, and diminished cultural values.

- **Costs Associated with Property Values** -- includes potential losses in land value to land owners abutting a river reach where a fish advisory is in effect.

- **Health Benefits from Contaminant Reductions** -- includes potential benefits of reductions in contamination of fish ingested by recreational and subsistence fishers and their families.

This section is not intended to provide in-depth guidance on how to estimate social and economic costs and benefits, nor should it be viewed as inclusive of all possible social costs and benefits associated with fish advisories. Rather, it is intended to give states an idea of the types of costs and benefits they should consider and how they might be estimated in the development of fish advisories. In addition, some examples of possible costs and benefits are provided. Note that the values presented in this section can not necessarily be applied to a particular situation without further data collection and analysis. Because fish advisories are site-specific, analyses of costs and benefits should be carried out on a case-by-case basis.

3.4.1. Methods for Estimating Costs Resulting from Fish Advisories

Recreational, subsistence, and cultural values must be considered when evaluating the economic and social costs associated with fish advisories. Each of these values could be reduced significantly due to the imposition of a fish advisory. To estimate the loss to each of these categories, the value derived by each must first be established. While the market value for commercially caught fish (i.e. price/lb) is easily established, fully capturing the cost of non-market goods such as recreational and subsistence fishing is more complex and difficult. Several approaches can be used to estimate values for non-market goods including but not limited to the travel cost, contingent valuation, and expenditure methods. These methods are summarized briefly below:

Travel Cost Method

The travel cost method (TCM) uses information on the costs that people incur to travel to and use a particular site to estimate a demand curve for that site. The method assumes that people who live X miles from a recreation site and who face time and travel costs in getting to the site would use the site just as frequently as people X + h miles from the site when faced with an admission fee to the site equal

to the additional time and travel costs associated with the distance h. From this assumption and observations regarding the frequency of use of different groups, a demand curve for the site can be traced out. The demand curve is then used to estimate the "consumer surplus" associated with the use of the site: in other words, the value that consumers receive from the site over and above the costs that they incur in using it. Consumer surplus is an estimate of the net benefits of the resource to the people using that resource. For example, if the resource is a recreational fishing site, the method can be used to value the recreational fishing experience (EPA, 1994b).

Contingent Valuation

In the contingent valuation (CV) method, surveys are conducted to elicit individuals' willingness-to-pay (WTP) for a particular good, such as a fishery or clean water. CV is more broadly applicable than TCM. Like the TCM, it can be used to estimate consumer surplus associated with recreational fisheries, but it can also be used to estimate less tangible values such as how much people care about a clean environment.

Expenditure Method

This method estimates the value of a non-market good based on total expenditures related to that good. For example, in the case of recreational fishing, total trip expenditures and equipment expenditures can be used to estimate the value of fishing to the angler. Although expenditures are an indicator of the value of the fishing experience, they do not reflect the net benefit associated with the experience (i.e., consumer surplus) as do the TCM and CV methods. If a fishery were to be shut down, recreational fishers would recoup what they would have spent on travel, equipment and other items. Their consumer surplus, however, would be lost. Although consumer surplus is a better measure of the economic value of recreational fisheries than simply expenditures, both are presented in this guidance document because states may be able to estimate expenditures more readily than they are able to undertake a TCM or CV analysis.

States may want to undertake more than one type of analysis as a check for consistency between the results of different methodologies. States should be careful not to double count fishing values, however, by adding the results of individual analyses.

3.4.2 Recreational Fishing and Tourism

To estimate recreational fishing values, states may want to use one of the

methodologies listed above. To undertake these analyses, states will need to collect information including but not limited to: numbers of fishing days per site per year, distances traveled by anglers per recreational fishing site, and recreational fishing-related expenditures per angler per site. States that wish to estimate fishing values using these approaches should contact the Office of Water in their EPA Region or at Headquarters as well as economics departments at state universities for further assistance. If conducting such analyses is not possible, states should at least qualitatively describe the possible impacts to recreational fishing of issuing a fish advisory.

Studies of economic value of recreational fishing have been conducted in many sites throughout the US over the past 30 years. To assist states, Table 3-2 summarizes and compares examples of reported recreational fishing day values based on travel cost methods, contingent valuation methods or expenditures. In 1991, freshwater fishers took an average of 13 trips each and fished an average of 14 days each (United States Fish and Wildlife Service (FWS), 1993). During this period, fishers spent an average of $596 each on trip and equipment expenditures, or approximately $41 per fishing day (FWS, 1993). These expenditures where divided between items such as: food, lodging, transportation, rods, reels, tackle boxes, camping equipment, boats, fishing licenses, and fishing magazines.

For the purpose of this comparison, all values have been normalized to 1992 dollars. For example, the $41 average expenditures per day in 1991 becomes $42 per day in 1992. As Table 3-2 indicates, the fishing day values range from $16 to $69 per day, with a mean of about $38 per day.

Table 3-2. Examples of Values Reported for Recreational Fishing

Type of Value	Value (1992$)	Source
Mean benefit/day of anadromous fishing	$67	Walsh et al. 1988 (in EPA 1993b)
Mean benefit/day of warm-water fishing	$24	Walsh et al. 1988 (in EPA 1993b)
Mean benefit/day of cold-water fishing	$38	Walsh et al. 1988 (in EPA 1993b)
Average value of a fishing day for trout, including resource costs (travel cost methods)	$23-35	Vaughan & Russell 1982
Average value of a fishing day for trout, including resource costs (contingent valuation method)	$31	Charbonneau & Hay 1978 (in Vaughan & Russell 1982)
Average value of a fishing day for catfish, including resource costs (travel cost method)	$16-23	Vaughan & Russell 1982
Average value of a fishing day for catfish, including resource costs (contingent valuation method)	$22	Charbonneau & Hay 1978 (in Vaughan & Russell 1982)
Total expenditures (including memberships, magazines, etc.) per day for sportfishing in general	$48	FWS 1993
Trip and equipment expenditures per day for sport fishing in general	$42	FWS 1993

The information provided in Table 3-2 should not be considered to be representative of all recreational fisheries. These values, therefore, should not simply be applied to a river reach where a fish advisory is under consideration. Rather, these values are meant to illustrate the relative value of certain types of fisheries and expenditures made on fishing in the US.

States may also want to develop their own approaches to estimating recreational fishing values, particularly where time and budget are limiting constraints. For example, the Arkansas Game and Fish Commission estimated the loss of fishing expenditures due to mercury-related fish consumption advisories based on decreases in fishing license purchases in counties where mercury advisories were issued. The decrease in licenses was multiplied by the average number of trips an angler takes per year, and by the average per-trip expenditures (EPA, 1994b).

States should also keep in mind that recreational fishers may have alternative sites that they would visit if a fish advisory were issued on a particular river reach. As such, the value assumed to be lost due to a fish advisory must be adjusted to account for the value (probably lower, or the fishers would be fishing there in the first place) of the substitute site. Similarly, anglers may just catch and release fish from waterbodies with advisories in effect, which would also have the effect of lowering the value of the fishing experience. Finally, states should consider the probability that some fishers may ignore the advisory, presumably resulting in increased health costs.

3.4.3 Subsistence Fishing and Food Costs

The impact of fish advisories to subsistence anglers may be more significant than to recreational anglers due to higher fishing days and consumption rates. This value, however, is not captured in the available recreational or commercial fisheries data. Because subsistence fishers and their families may rely on the fish they catch as their primary protein source, states should consider the cost to subsistence fishers and their families to switch to a more expensive protein source. As a rough approximation, states will need to estimate an average cost difference between fish and alternative protein sources and apply this difference to an estimate of kg/day consumed per person. In addition, states should consider the extent to which nutritional value is simply lost if substitute foods are not purchased.

3.4.4 Costs Associated with Property Values

Society places a premium on certain amenities associated with property (e.g. size of lot, proximity to waterfront, scenic views, etc) evidenced by price differentials among properties with varying degrees of these amenities. Where an amenity is

degraded, landowners are likely to experience a reduction in their property value. As such, owners of land adjacent to waterbodies where fish advisories are in effect may experience a decline in property value. One common approach to evaluating the impact of changes in a particular attribute to total value is the hedonic price technique. This technique is a method for estimating the implicit price of the characteristics differentiating closely related products in a product class. Hedonic pricing is based on the observation that a market good can be represented as a bundle of characteristics that describe the good; for example, a house can be described in terms of lot size, square footage of the house, number of rooms, proximity to an amenity such as waterfront, and any other number of features. In principle, if there are enough models with different combinations of features, an implicit price relationship can be estimated giving the price of any model as a function of its various characteristics. For example, by observing how the selling price of the house varies with, say, proximity to waterfront, the implicit value of proximity to waterfront can be determined (Freeman, 1979). If the quality of the water in a waterbody is degraded to the point where a fish advisory is issued, the implicit value of the proximity to waterfront variable is expected to decrease[3].

States should consider this cost as part of the total cost when establishing fish advisories. States may want to describe potential rather than quantified impacts to property values, however, since using the hedonic price technique requires detailed time series and cross-sectional data on property values and attributes and regression analysis.

3.4.5 Benefits Associated with Health Advisories

Although fish advisories will create costs, they may result in monetary benefits in the form of reduced adverse health effects to society. As such, it is important for agencies to consider both potential costs and benefits when issuing fish advisories. Consumption of contaminated fish can cause health problems, particularly for sensitive subpopulations. For example, infants are more susceptible to certain pollutants, (e.g., mercury, lead) than adults. In addition, populations that consume more fish than the general population (e.g., sport fishers, subsistence fishers, and their families) may be at greater risk. Establishing fish advisories should therefore reduce these adverse health effects; however, this has not been scientifically established. States should also keep in mind that, to the extent that these groups are not aware of fishing advisories or are unwilling to observe them, the benefits of issuing a fish advisory may be minimized.

[3] Other effects that influence changes in total value would have to be addressed in any analysis undertaken by states.

Cost of Illness Approach

To estimate the benefits of fish advisories, risk managers should first consider the economic impact of adverse health effects. Where adverse health effects are avoided due to a fish advisory, this impact can then be considered a benefit of the fish advisory. There are two methods for measuring the economic value of health effects. One, the "cost-of-illness" (COI) approach, measures the effects of illness that are directly observed in the marketplace, such as lost wages and medical costs. To use COI, states would have to collect data on the number of individuals, by subpopulation, expected to require a particular type of medical care, the medical cost of each treatment scenario, and the expected lost wages per affected individual. For an example of the COI approach, states can refer to an EPA document titled *The Medical Costs of Five Illnesses Related to Exposure to Pollutants* (EPA, 1992d).

Willingness to Pay Approach

The second approach measures the total value of health effects by estimating an individual's willingness-to-pay (WTP) to avoid them. The WTP approach should include the cost of illness, but also includes other less tangible costs such as pain and suffering. This approach provides a more complete estimate of the economic value of health effects than does the COI approach, but it is more difficult to use because costs such as pain and suffering are not valued in the marketplace. Two methods can be used to measure WTP. In the first, the contingent valuation (CV) method, surveys are conducted to elicit people's willingness to pay to avoid a particular health effect such as cancer. In the second, information available on the monetary tradeoffs people make between income and health risks is used. For example, people in occupations with a higher risk of death than other occupations generally command a higher wage, all other factors being equal. Similarly, people pay for items such as car air bags that reduce the risk of death. Dividing the wage premium for a risky job, or the cost of risk-reducing products, by the change in risk yields an estimate of the "value of a statistical life." This value represents an aggregation of small changes in risk across a population, rather than the value of the life of a particular individual (EPA, 1994b).

Life Valuation

The literature on the value of a statistical life is well developed. Based on a survey of this literature, values can range from $2 million to $10 million (1992 dollars) (EPA, 1989; Violette and Chestnut, 1983, 1986). These values, however, will be useful to states only in cases where fish advisories are expected to avoid fatal effects (such as cancer) associated with the consumption of contaminated fish.

Where fatal effects are possible, an estimate can be made of the number of deaths expected.

Illness Valuation

Some limited information is available on the value of nonfatal effects like nonfatal injuries, bronchitis, hospital visits, and respiratory symptom days. These effects, however, may not be relevant to the types of health effects typical of fish consumption. Other effects, such as decreased IQ can result in costs to society and other opportunity costs that states may choose to incorporate into their assessments. States interested in pursuing either the COI or WTP approach should contact the Office of Water at EPA Headquarters in Washington, D.C., as well as economics departments at state universities for further assistance.

3.5 Legal and Treaty Rights

The legal and treaty rights of individuals and groups with respect to land and activities can have a direct bearing on the authority of agencies to act regarding fish contamination. Interference or alteration of these rights may also be a significant consideration when evaluating program impacts. To the extent possible, fish advisory programs should be designed to minimize negative impacts on the rights of both the populations at risk and any other persons who have rights with respect to the waterbodies and land under consideration. Consequently, legal and treaty rights must be evaluated and interpreted when developing fish advisory programs. More detailed information on the legal aspects of this issue are beyond the scope of this document. State, federal, local, and tribal laws may govern in this area and it may be advisable to obtain legal counsel when such issues arise.

3.6. Summary

Numerous impacts of fish advisory programs on individuals, communities and local economies are possible. A brief overview of some categories of these impacts has been provided in this section. Risk managers and policy makers are encouraged to discuss various options for controlling fish consumption with community members and leaders to obtain a comprehensive understanding of the impacts likely to occur as a result of the options under consideration. This type of information gathering will also be an opportunity to discuss various aspects of risk and fish contamination. Such discussions provide a mechanism for educating both policy makers and community members regarding the issues surrounding fish contamination problems and potential resolutions. Readers are encouraged to review Volume IV: Risk

Communication regarding various aspects of communicating risks to the public.

The various fish advisory options, discussed in Section 2, have varying potentials for impacting community relations, tourism, property values, individual actions, traditional practices, and health. The extent of these impacts will depend on specific characteristics of the populations affected by fish advisories and the nature of the fish advisory program. Consequently, local information, combined with specific plans regarding fish advisories, are needed to evaluate the relative advantages and disadvantages of various options. Table 3-3 provides a template for entering information regarding impacts of limiting consumption. This template is similar to the one provided in Section 2, allowing risk managers to enter critical information to be used to compare various options. The options discussed in this section are all listed in the template; however, the risk manager may choose to consider only some of these options or may add other others which are not listed.

Risk managers may elect to enter some indicator of impacts in the various cells (e.g., low, moderate, high), estimated costs (where applicable), number of people affected, or some other method of indicating the magnitude of an impact. The type of information entered will depend on what data is available and what would prove most useful to the decision-making process. Although information is not likely to be available on the costing of benefits resulting from reduced illness associated with contaminant exposure, the column is provided for the reader's convenience.

Table 3-3. Template for the Impacts of Risk Management Options

Risk Management Options		Nutrition	Cultural Impacts		Economic Impacts			Benefits of Health Advisories[4]
			Traditional Activities	Dietary Patterns	Recreational Fishing & Tourism	Subsistence Fishing & Food Costs	Property Values	
No action								
Fish consumption advisory	General guidance							
	Quantitative Guidance							
Catch and release	Voluntary							
	Mandatory							
Fishing ban	Voluntary							
	Mandatory							

[4] Benefits are associated with reduced risks. These can be determined from risk assessment results (see Table 2-9) and from associated health information provided in Volume II. Entries may consist of quantitative information, such as the number of people who will not be at risk as a result of a program, or qualitative indicators of effects. Risk managers may also want to add a column for corresponding reductions in the benefits of fish consumption (as discussed at the beginning of this section).